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Complete Specification for the invention entitled: "ADHESIVE AND COHESIVE COMPOSITE MATERIALS AND SHEETS"

20 SEP 1974
PATENT OFFICE

The following statement is a full description of this invention, with the best method of performing it known to ~~me~~/us:-

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The present invention relates to a composite material, non-tacky to the touch, which will adhere to a surface or cohere to itself simply by the application of moderate pressure. More specifically, in certain advantageous embodiments it relates to a medical-surgical wrapping in the nature of an adhesive or cohesive bandage, tape, closure, or the like, which is highly breathable, convenient to use, comfortable to wear and inexpensive to produce.

While the present invention will be described in connection with particular embodiments designed for application in the medical-surgical field, it should be understood that the use of the invention is not necessarily limited thereto. It can be employed for various other home, commercial and industrial applications, as will become apparent to those skilled in the art as the description thereof proceeds.

Techniques for holding surgical pads, bandages and the like in place vary depending upon the specific application involved. Surgical dressings, for example, may be held in place by an overwrap bandage which in turn is tied, taped, or clipped in place. Such techniques, while quite common and highly developed, often leave much to be desired. The overwrap bandage sometimes creates conformability problems when wrapping an irregularly-shaped member of the body and undesired immobilization of the member when applied to joint areas or the like. After wrapping, the bandage must still be held in place by tapes, clips or ties, which of themselves present problems. Thus, for example, the tacky adhesive

surface of tape presents handling and unwind problems and collects lint, dust and dirt, thereby decreasing adhesion and presenting antiseptic problems. Because of the "quick grab" characteristic of the exposed tacky surface, it is difficult to adjust and reposition the tape as it is applied. Adhesion of the tape to the underlying skin also may lead to painful problems of removal.

It is therefore a general object of the present invention to provide an alternative to conventional bandages, tapes, ties, closures, strapping and the like, which does not suffer from such shortcomings of the prior art structures. It is another general object to provide a new concept in such products which permits the structure to be tailored to the requirements of the particular end use.

A more specific object of the present invention is to provide a low cost, highly-conformable adhesive or cohesive composite material which is non-sticky and non-tacky to the touch and yet will stick to a surface or similar article upon the application of light or moderate pressure. It is another specific object to provide a highly-versatile, non-fouling flexible wrapping which has good unwind properties and no requirements for an inter-liner. It is another specific object to provide single and double-faced pressure-sensitive tapes which are free of "quick grab" and can be easily moved around on a surface to the desired position until pressed to gain adhesion.

It is another specific object to provide a stretchable bandage having adhesive or cohesive properties, which

bandage may be readily removed and reused without substantial loss of adhesiveness or cohesiveness. It is a still further object of the present invention to provide a low cost cohesive bandage which adds a protective layer to the area bandaged. These and other objects of the present invention will become apparent as a detailed description thereof proceeds.

These objects are achieved in a particular embodiment of the present invention by a medical-surgical wrapping which comprises outer flexible webs or layers, at least one of which comprises open-cell, compressible polyurethane foam or equivalent having a pore count or cell density in the range of about 30 to 120 pores or cells per running or linear inch (hereinafter abbreviated "ppi"). An intermediate layer is sandwiched between and is secured to the flexible outer layers and comprises a porous flexible mass having cementitious properties, i.e., adhesive or cohesive properties, or both. The intermediate layer has sufficient plasticity that a portion of the mass will extend through the pores of the foam when an external compressive force is applied to the outer webs so as to compress the foam and expose the intermediate layer at the exposed surface thereof for adherence or coherence.

The flexible, compressible, open-cell polyurethane foam preferably used in one or both outer layers may be either polyester or polyether polyurethane foam, typically having a density in the range of about 1 to 6 pounds per cubic foot and a pore count in the range of about 30 to 120 ppi, prefer-

ably about 50 to 100 ppi. Polyester polyurethane foams are preferred in the practice of the present invention because cell size may be more readily controlled and because of their superior tensile strength characteristics. A typical polyester polyurethane foam may be prepared, for example, as set forth in Example II of U.S. Patent 2,956,310.

Polyurethane foams having substantially less than about 30 ppi should normally be avoided because the adhesive-type masses can be detected through the large pores with even the slightest pressure, resulting in an excessively tacky feel. However, if strictly cohesive or substantially cohesive masses are used then foams with somewhat less than 30 ppi can be used if their other properties are satisfactory for the intended use. There is also a limiting factor insofar as slicing the foams on a production basis is concerned. It is difficult to slice foams to below about 1/8 inch thickness when the foams have substantially less than about 30 ppi. As set forth hereinafter, foam layer thicknesses of less than 1/8 inch are preferred for many applications. Another limiting factor for the larger pore size foams is that they are harsher to the feel than the finer pore sizes.

These problems are not usually present with open-cell foams having pore counts above about 30 ppi. Above about 120 ppi, however, the pores are so fine that little of the mass is exposed at the surface when the foam is compressed, thus reducing desired adhesive or cohesive properties.

While completely open cellular foams are preferred, such as those known in the trade as "reticulated" foams where the

cell walls have been removed by chemical or mechanical treatment, foams having open cellular structures of about 50% open cells or more may be employed. The partially reticulated and non-reticulated foams are generally somewhat less in cost and may be used where a cost saving is desired although the fully reticulated foams are preferred. These foams have a satisfactorily high MVT (moisture vapor transfer), e.g., about 50 to 2500 grams per 100 square inches in 24 hours. The porous open cellular structure of the foam permits highly porous wraps to be prepared if desired by incorporating a porous or open intermediate layer of mass.

Because of the cell walls present in the non-reticulated and partially reticulated foams, the preferred pore sizes may be somewhat larger than in the case of fully reticulated foams. For example, in a particular embodiment using identical masses, about 80 ppi may be optimal in the case of a fully reticulated foam, whereas about 60 ppi may be optimal for a partially reticulated or non-reticulated foam.

Because good conformability is desired for many applications and conformability is usually enhanced if the product is stretched slightly when applied, the polyurethane foam should have an extent of elasticity such that it can be stretched in any direction at least about 10% beyond its original dimension and return upon release and preferably about 65 to 70% beyond its original dimension. The ultimate elongation before rupture is typically substantially greater, e.g., about 100 to 400%, or two to five times its original dimension.

To assure that the product can be stretched without requiring excessive forces, the 100% modulus (the force per unit width required to stretch the product 100% beyond its original dimension) should preferably be no greater than about 5 pounds per inch width, optimally less than about 3.0 pounds, e.g., 0.5 to 2.5 pounds per inch width. The 100% modulus is, of course, related to thickness.

The preferred thickness of the product depends upon its ultimate use. For a cohesive bandage, the total thickness should be not substantially in excess of about 1/8 inch, thus limiting each of the two outer layers to about 1/16 inch or less, e.g., about 1/32 inch, the balance being the intermediate mass layer. Otherwise excessive thickness of the bandage would render it susceptible to easy dislodgment during wear.

By the same token, each of the outer layers should probably not be thinner than about 1/48 inch. Otherwise the bandage may be too weak except possibly for very special uses. Also, as previously indicated, slicing foams to such fine dimensions can be difficult and may not be feasible on a production scale.

Even thinner layers might be used if a reinforcing coating or impregnant for the polyurethane foam is employed. Suitable strengthening impregnants include acrylic latex binders, thermoplastic polyurethane used in emulsion or solution form such as Estane (thermoplastic polyurethanes for solution application sold by B.F. Goodrich Chemical Co.) and ionomer resin dispersions such as described in U.S. Patent

3,322,734 and presently sold by E.I. du Pont de Nemours & Company, Inc. under the trade name Surlyn D 1230. The suitability of other impregnants can readily be determined by those skilled in the art. The impregnants may be added by conventional techniques, including padding, gravure roll, and the like.

For protective use around parts of the body and in non-medical and non-surgical embodiments, one or both outer layers may each have a thickness substantially greater than 1/16 inch. Also, for certain industrial uses, even substantially thicker outer layers may be employed, in which case larger pore sizes may be employed consistent with meeting tackiness specifications.

Where limited stretch or no stretch is desired and conformability is not a particular problem, a material imparting such desired stretch properties can be substituted for one of the outer layers. For example, in the closure embodiment, which may take the form of opposed tabs which are overlapped and pressed together for cohesion, the non-contacting surfaces may comprise a substantially non-stretchable woven or non-woven fabric, paper, non-woven plastic film or the like. Also, the foam-adhesive laminate structure may be used solely as a securing means for attaching articles containing the same to another surface. In such instance the surface of the article itself, which could be flexible or rigid, porous or non-porous, could take the place of one of the outer layers.

Where flexible sheet material with two potentially adhesive sides are desired, the sheet material having little or

controlled elongation or stretch, this can best be accomplished by incorporating between the outer foam sheets stretch-modifying means. The stretch-modifying means may be placed between the adhesive and one or both foam sheets if the stretch-modifying means is sufficiently open to permit the adhesive to pass therethrough and be accessible when the foam is compressed, such stretch-modifying means being, for example, threads, open mesh gauze, and the like. If the stretch-modifying means is incorporated within the adhesive layer, it is not necessary that the same be pervious; and creped paper, closer weave fabric or other suitable means may be employed. The stretch-modifying or controlling means may be formed of elastomeric material where modified stretch or enhanced return properties are desired. Thus, for example, the stretch-modifying means may be formed of rubber, polyurethane, or other elastomer.

Open-cell polyurethane foams useful in preparing the structure of the present invention may be obtained from commercial sources. These include, for example, 80 ppi, Scott reticulated foam as sold by the Foam Division, Scott Paper Company, Chester, Pennsylvania, and 65 ppi substantially non-reticulated P 4104 Foam as sold by the General Foam Division, Tenneco Chemicals, Inc., New York, New York.

While the open-cell polyurethane foams are preferred, certain functionally equivalent foams, such as, for example, vinyl foams, styrene-butadiene foams and some rubber based foams, may be substituted. Because some of these other foams are usually closed cell, perforation thereof to pro-

duce pores would be necessary, as those skilled in the art will recognize in the light of this disclosure.

The mass which makes up the intermediate layer can be any conventional adhesive mass which has the characteristics required in the end product, the particular type per se not being part of the present invention other than being a necessary part of the claimed construction. As used herein, the term "adhesive mass" encompasses pressure-sensitive masses which are adhesive in the sense that the mass will adhere to a variety of different surfaces, including the surfaces of dissimilar materials, upon application of at least slight pressure, or which are cohesive in the sense that the mass will adhere only to itself upon application of slight pressure, or both. A "cohesive mass", as the term is used herein, encompasses only the latter, that is, a mass which will normally adhere only to itself upon application of slight pressure, and normally would exhibit little or no tack, although any such tack can be decreased or eliminated as hereinafter set forth.

The mass must be such that it can be secured to the outer layers and must have sufficient plasticity to extend through the pores thereof upon application of convenient compressive forces so as to contact and adhere or cohere to the opposed surface. In the medical-surgical field, the mass must also have acceptable clinical properties, e.g., inert, non-irritating and non-allergy forming, and should preferably lend itself to sterilization. In addition, the mass should be substantially porous to complement the porosity of the

outer layers, resulting in a product which breathes and minimizes maceration of the underlying skin.

The requisite plasticity is, of course, related in part to the pore size and thickness of the outer polyurethane foam layer or layers. In general, when using 1/32 inch foam layers having pore counts in the range of 50 to 100 ppi, "Williams" plasticities in the range of about 1 mm to 8 mm have been found operative. Masses having "Williams" plasticities substantially less than about 1 mm are usually too tacky when pressed for satisfactory results. Masses having "Williams" plasticities substantially above about 8 mm are usually too hard and require too much pressure for most applications.

"Williams" plasticities as referred to herein are determined with a Williams Plastometer at 100°F using a ball of mass weighing 2 grams placed between two opposed plates protected with controlled-thickness paper. A 5 kilogram weight is applied, and the separation of the plates measured after about 15 minutes, adjustment being made for the thickness of the paper. The greater the separation, the greater the plasticity of the material. The mass sample is preconditioned in the 100°F plasticity oven for about 14-15 minutes prior to running the plasticity.

In the medical-surgical field suitable adhesive masses which can be formulated to meet these various requirements may be, for example, the well-known elastomeric-based surgical adhesive type masses and the acrylate pressure-sensitive adhesives presently used in surgical adhesive tape

constructions. One operable form of the latter is a pure rubbery copolymer of isooctyl acrylate and acrylic acid in a 94:6 ratio, as described in U.S. Patent 2,884,126 (Re.24,906). A technique for disclosing the desired microporous structure therein so as to achieve a high MVT, e.g., about 50 to 500 grams per 100 square inches in 24 hours, is described in U.S. Patent 3,121,021. Other examples of suitable adhesives are set forth in U.S. Patents 2,877,141, 2,909,278, 3,307,544 and 3,325,459.

One may use as suitable cohesive masses the commercially-available natural rubber latices designated "Uniroyal NC400 M-30" and "Uniroyal 11-35X creamed 356" as sold by United States Rubber Company. Other suitable commercially-available rubbers, which are cohesive, include, for example, Natsyn 400, 410 and 450, which are essentially synthetic cis-polyisoprene rubbers sold by The Goodyear Tire and Rubber Co. These rubbers should preferably have antioxidants incorporated so as to prevent their deterioration. Some of the self-adhering silicone rubbers that are suggested in U.S. Patent 3,439,676 may also be satisfactory. A number of the aforementioned masses are sterilizable, thus enhancing their use in medical-surgical embodiments.

Typical "Williams" plasticity data obtained on such masses are as follows:

Mass	"Williams" Plasticity, mm. (Plate Separation at 100°F)
Elastomeric-Based, Surgical Adhesive-type Mass (Pigmented)	1.6 - 2.0
Elastomeric-Based, Surgical Adhesive-type Mass (Clear)	1.8 - 2.2
Acrylic A*	2.1 - 2.4
Acrylic B*	1.8 - 2.4
Natsyn 400	4.51 - 4.53
Natsyn 410	2.12 - 3.56
Natsyn 450	1.85 - 2.12
Uniroyal NC400 M-30	7.95

* See teachings of U.S. Patent 2,884,126

All of these masses produce good cohesive bandages, although some are better than others. For example, a bandage made with Natsyn 400 exhibits essentially no tack, in contrast to the undesired tackiness of a cohesive bandage made with Natsyn 450. A cohesive bandage made with Uniroyal NC400 M-30 also exhibits no tack but the pressure required to obtain substantial coherence is considered excessive.

The formulation of the normally-tacky masses can be adjusted to decrease or eliminate the tackiness. For example, the addition of silicone fluids to a tacky mass often renders it substantially non-tacky without substantially affecting coherence. Such modifications greatly expand the type of masses that can be used in making non-tacky cohesive bandages. Also, because tack would no longer be a problem, foams having large pores, e.g., 30 to 50 pores per inch or even somewhat

less, could be used in making satisfactory bandages if other requirements are also met.

The thickness of the porous mass making up the intermediate layer depends upon the nature of the mass, the thickness and nature of the outer layers and the end use of the finished product. For example, in the case of cohesive bandages for use in holding pads or dressings against the skin wherein 1/32-inch outer layers of 80 ppi Scott reticulated foam are employed, the mass thickness may be in the range of about .5 to 10 mils. Depending upon the particular mass, the mass weight may be in the range of about .2 to 2.5 ounces per square yard, typically about 0.5 to 1.5 ounces per square yard. For other uses, however, wherein thicker foam layers may be utilized, substantially thicker mass layers would normally be required. In general, the optimum formulations, thicknesses and the like can best be determined for a particular use by experimentation, as will be apparent to those skilled in the art in the light of this disclosure.

The present invention will be more clearly understood from the following detailed description of specific embodiments, read in conjunction with the accompanying drawings, wherein:

Figure 1 illustrates in magnified cross section a fragmentary portion of an embodiment of the present invention wherein two outer polyurethane foam webs and an intermediate mass layer are employed;

Figure 2 is similar to Figure 1 and illustrates the embodiment wherein an open mesh web (or other material) is im-

bedded in the intermediate mass layer;

Figure 3 is similar to Figure 1 except that one of the outer foam webs has been replaced by a fabric backing;

Figure 4 is similar to Figure 1 and illustrates the embodiment wherein the intermediate mass layer overlaps into the outer foam layers;

Figure 5 is similar to Figure 1 except that the intermediate layer comprises a mass-impregnated foam;

Figure 6 illustrates the use of the embodiment of Figure 3 in one form of closure; and

Figure 7 is a schematic diagram illustrating one method of producing the embodiment of Figure 1 of the present invention.

It should be understood that the structures are represented in the drawings by graphic symbols and that the drawings are not to scale. As a result, the representations necessarily depart from the actual appearances of the various constructions.

Referring to Figure 1, a preferred embodiment of the present invention may comprise outer flexible webs 10 and 12 of compressible open-cell polyurethane foam, each having a thickness of about 1/32-inch and a pore count in the range of about 30 to 120 ppi. Webs 10 and 12 are laminated by conventional techniques to intermediate layer 14 comprising a porous mass having cementitious properties, i.e., adhesive or cohesive or both, and sufficient plasticity to extend through the pores of webs 10 and 12 when the latter are compressed. In a specific embodiment, intermediate layer 14 may comprise,

for example, Natsyn 400 synthetic cis-polyisoprene cohesive mass having a thickness of about 1-6 mils and a "Williams" plasticity of about 4.5 mm.

Because the mass layer 14 is protected by outer foam layers 10 and 12, it is not exposed to the touch or extraneous lint, dirt or dust in normal handling and presents a neat, clean appearance. It is not tacky or sticky and has good unwind properties, and requires no interliner. Even when using a tacky mass as layer 14, the absence of "quick grab" permits it to be readily moved around on a surface to a desired position. Yet the structure will readily adhere or cohere upon application of moderate pressure and can be separated again and reused as desired. The non-fouling outer layers also act as a cushion to the underlying surface, e.g., a bandaged wound.

Another advantageous attribute of the embodiment of Figure 1 is that the structure is stretchable and highly conformable, as well as being quite porous. Where limited stretch or no stretch or other characteristic is desired, materials imparting such desired properties can be added to the construction, as illustrated symbolically in Figure 2, or substituted for one of the outer foam layers, as illustrated in Figure 3.

Specifically, in Figure 2 an open mesh fabric (or other desired material) represented by dashed line 16 may be imbedded in mass layer 14. Fabric 16 may comprise, for example, cotton gauze having 20 warp and 20 weft threads per square inch. While fabric web 16 is illustrated as being imbedded

in the middle of the mass, it need not be and can be disposed adjacent an edge of the mass. Also, a plurality of such webs may also be employed, e.g., a web adjacent each edge of the mass. The web must not, of course, unduly interfere with the ability of the mass to enter the pores of the outer foam layer or layers.

Alternatively, a non-stretch or limited stretch outer layer 18 may be substituted for flexible web 12 as illustrated in Figure 3. For example, outer layer or backing 18 may comprise a tightly woven cloth backing having 109 warp and 58 weft threads per square inch or may be formed of polymer film, paper or other flexible substantially adhesive-impermeable material. This embodiment is particularly useful as a surgical tape or closure. The foam side has substantially no tack and yet will cohere to an opposed similar foam side when the two foam surfaces are pressed together. The backing surface, however, exhibits no tack and no cohesiveness because the tightly-woven cloth layer 18 or film does not permit the mass to come through. Imbedded fabric 16 may also comprise a variety of other webs or strands, e.g., woven or non-woven cloth, paper (including micro-pleated and creped paper), woven or non-woven plastic, strengthening strands, filaments, rovings, or fibers of various types, including fiber glass, and the like.

Figure 4 illustrates an embodiment wherein the mass 20 is impregnated part way through foam layers 22 and 24. This is advantageously employed in thicker laminates, e.g., 1/8-inch or thicker. The mass may penetrate to within 1/32-inch

(or even possibly less) of the foam surface. Because the mass is below the surface, the structure is non-tacky to the touch but, depending upon the nature of mass 20, may be adhered to another surface or cohered to a similar structure by pressing the same together.

A somewhat related construction is illustrated in Figure 5 wherein the intermediate layer 26 comprises a third foam layer impregnated throughout with the desired adhesive or cohesive. The foam of intermediate layer 26 may or may not be substantially identical to the porous open-cell polyurethane foam making up outer layers 28 and 30.

Figure 6 illustrates how the embodiment of Figure 3 may be employed as a closure having properties similar to the popular "Velcro" fishhook-type of closure. A typical closure may comprise opposed tabs A and B which are respectively secured to the two halves of a garment or the like which is to be closed, e.g., disposable surgical gown, disposable diaper, or other article. Each of the tabs comprises non-stretch fabric backings 32 having an adhesive area 34 at one end of each for adhering the tabs to the respective portions of the garment or other article to be closed. The adhesive 34 may comprise, for example, a conventional hot melt or thermosetting adhesive. The other end of each tab has secured thereto a cohesive mass 36 which is covered by open-cell polyurethane foam 38. Tabs A and B form a closure simply by pressing the foam covered surfaces together whereby the foam is compressed and cohesive masses 36 contact one another and hold the tabs together.

Production of the embodiments of Figures 1 and 2 is illustrated in Figure 7. Outer webs comprising open-cell polyurethane foam layers 40 and 42 are unwound from rolls 44 and 46, respectively, and are coated with thin layers of a solution 47 and 48 of a cohesive mass, e.g., a 12% to 15% solids solution of Natsyn 400 synthetic cis-polyisoprene mass in a mixture of xylene and toluene, from supply vessels 49 and 50 by means of coater rollers 52 and 54, respectively. Metering rolls or knives (not shown), or equivalent, may be employed to control the thickness of the mass coating. The coated foam from roller 54 joins the coated foam from roller 52 at the nip of rolls 58 and 60, where the cohesive coatings are lightly pressed together to form a laminated structure 62. The laminated structure is then dried (desolventized) in oven 64, operating at, for example, 250°F-275°F, and the resulting product 66 is then accumulated on product roll 68.

The embodiment of Figure 2 is produced by imbedding an open mesh fabric 70 (or other desired material) from supply roll 72 into the cohesive mass. This can be readily accomplished by introducing fabric 70 into the nip of rolls 58 and 60 where the cohesive solution layers on each of the foam layers are joined together. As a result, fabric 70 is imbedded and anchored in the cohesive mass during the drying step.

The embodiment of Figure 3 may be produced essentially as described above in connection with the embodiment of Figure 1 except that a non-foam substantially impervious backing 18 is substituted for foam layer 12. The embodiment of

Figure 4 may be produced by casting the mass on silicone-coated paper, and while the mass is still wet, lay the foam on top and then roll with moderate pressure so as not to drive the mass all the way through the foam. After drying the mass and removing the silicone-coated paper, fold the mass-coated foam in half, mass to mass, to make the bandage. The embodiment of Figure 5 may be prepared by thoroughly impregnating a foam layer all the way through with the mass to produce the intermediate layer 26 and then rolling outer layers 28 and 30 thereon to produce the laminated structure.

The present invention will be more clearly understood from the following specific examples.

Example 1

A 1/32-inch thick, stretchable, open-cell sheet of polyurethane foam was dipped in a 10% solids solution of an acrylic mass (similar to that described in U.S. Patent 2,884,126). The wet sheet was drained, dried, and then cured at 250°F. To this intermediate layer two sheets of uncoated 1/32-inch thick, stretchable, open-cell polyester polyurethane foam was laminated.

The resulting bandage or tape was found to be very air permeable and, when wrapped around a human hand, was found to be very comfortable. The outer layers did not have a tacky or sticky feel and the bandage was adhered to itself by the application of moderate pressure. The bandage could be removed with ease and resecured as desired.

Example 2

An acrylic mass similar to that of Example 1 was cast on

silicone-coated paper, dried in a steam cabinet for about 2 minutes and then blown in an oven at about 250°F for about 5 to 7 minutes. The resulting porous mass was laminated in one case to a 1/32-inch thick, open-cell, stretchable polyurethane foam and in a second case to an approximately 1/28-inch thick, open-cell, stretchable polyurethane foam. After removing the silicone-coated papers, second layers of open-cell, stretchable polyurethane foam having corresponding respective thicknesses were laminated to the mass surfaces.

Each of the resulting tapes or bandages was wrapped around a human finger and then pressed together to gain cohesion. The cohesion for the 1/32-inch foam was slightly better than that for the 1/28-inch foam.

Example 3

A 40%-solids solution of a pigmented elastomeric-based surgical adhesive type mass in xylene was spread using a bar coater set at 15 mils on a 3-mil Daubert silicone-coated paper. Before the mass dried, a sheet of 20 x 12 gauze was laid on top and then on top of this was placed a sheet of 1/32-inch thick, 80 ppi, Scott reticulated foam. After laying another sheet of the silicone-coated paper on top, the sample was rolled, using light to moderate pressure so that only the lower surface of the foam was imbedded in the mass. After rolling, the upper silicone-coated sheet was removed and the remaining composite was dried in a steam cabinet for 15 minutes at 160°F.

Another mass coated foam sheet was prepared as described in the preceding paragraph but without using the gauze. The

resulting two sheets were removed from their respective carriers and then placed mass-to-mass and rolled lightly to prepare a closure. The "Williams" plasticity of the mass was about 1.6 to 2.0 mm.

When pressed against itself, the closure formed a very good bond and exhibited no stretch. Because too much of a mass layer was present and was imbedded slightly too deeply in the foam, the closure exhibited slightly too much tack when pressed firmly.

Example 4

As in Example 3, a 40%-solids solution of a pigmented elastomeric-based, surgical adhesive type mass in xylene was spread using a bar coater set at 15 mils on 3-mil Daubert silicone-coated paper. Before the mass dried, 1/32-inch thick, 80 ppi, Scott reticulated foam was placed on the mass surface. After placing another sheet of the silicone-coated paper on top, the sample was rolled just hard enough to partially imbed the one surface of the foam in the wet mass. The upper silicone-coated paper was then removed, and the composite was dried in a steam cabinet for 15 minutes at 160^{o}F. The "Williams" plasticity was about 1.6 to 2.0 mm.

The resulting mass-coated foam was removed from the silicone-coated paper and then laminated, mass surface to mass surface, to a commercially-available surgical adhesive tape having a 109 x 58 cloth backing (ZO adhesive tape as sold by Johnson & Johnson) to form a closure tape.

When pressed foam layer to foam layer, the closure tape formed a strong bond and worked very well. The closure tape

exhibited no stretch and had no tackiness on its outer surface. The foam surface also had no tack when pressed lightly and only slight tack when pressed heavily.

Example 5

Five samples of a bandage material were prepared by spreading a 30%-solids solution of a pigmented elastomeric-based, surgical adhesive mass (same as in Examples 3 and 4) in toluene on a 4-mil silicone-coated paper by means of a bar coater, the setting of the latter being varied from 10 to 21 mils to produce the various samples. In each case, while the mass was still very wet, 1/32-inch thick, 80 ppi, Scott reticulated foam was placed on top and then rolled lightly. Following this, the composite was dried in a steam cabinet at 160°F for 15 minutes. After drying, the mass-coated foam was removed from the carrier, folded over mass-to-mass, and rolled lightly to produce the cohesive bandage. The "Williams" plasticity was about 1.6 to 2.0 mm.

Inspection of the five samples showed the following :

Sample	Bar Coater Setting in Mils	*Mass Wt., oz./yd.^{2}	Cohesion Tested By Hand	Porosity (Visual)
1	10	0.26	Fair to poor	Very good
2	13	0.44	Good when wound tightly	Very good
3	16	0.63	Very good	Very good
4	19	1.07	Very good	Very good
5	21	1.13	Very good	Very good

* Two layers weighed. As above indicated, two layers of foam and two layers of mass make up the bandage.

The peel cohesion tests indicated the following when 1-inch wide samples were placed against 1-inch wide samples and rolled six times at a rapid rate with a 4-1/2 pound roller:

Sample	Mass Wt., $oz./yd.^2$	Peel Cohesion, oz./in. Width
1	0.26	0.7
2	0.44	2.1 to 3.1
3	0.63	5.8 to 8.1

Example 6

Four additional samples were prepared as described in Example 5 except that the elastomeric-based mass differed slightly, primarily by the omission of pigment, and the solids content of the mass solution was varied. The "Williams" plasticity of the dried mass was about 1.8 to 2.2 mm.

Inspection of the four samples showed the following:

Sample	Solids in Mass Solution, Wt.%	Bar Coater Setting in Mils	Mass Wt., $oz./yd.^2$ (2 layers)	Cohesion Tested By hand	Porosity (Visual)
1	20	-	2.79	Excellent	Fair
2	30	11	-	Excellent	Fair
3	20	10	0.89	Very good	Very good
4	20	9	0.68	Good	Very good

Example 7

Four additional cohesive bandage samples were prepared using the same mass as in Example 6 but using a different method of preparation. In each case, the mass was spread on a silicone-coated paper carrier, and the foam was applied

while the mass was wet and then was removed before the mass had a chance to dry. The mass that adhered to the one surface of the foam was then dried for 15 minutes in a steam cabinet at 160°F. The bandage was prepared by folding over, mass-to-mass, and then rolling lightly.

Inspection of the four samples showed the following:

Sample	Solids in Mass Solution, Wt.%	Bar Coater Setting in Mils	Mass Wt., oz./yd.^{2} (2 layers)	Cohesion Tested By Hand	Porosity (Visual)
1	20	-	0.62	Good	Very porous
2	20	12	0.60	Not good enough	Very porous
3	30	14	1.36	Good to very good	Very porous
4	30	16	1.5	Very good	Good porosity

Example 8

Five additional samples were prepared in the same manner as described in Example 5 except that a different mass solution was employed, i.e., a 20%-solids solution of Natsyn 410 synthetic cis-polyisoprene in a mixture of xylene and toluene.

Inspection of the five samples showed the following:

Sample	Bar Coater Setting in Mils	Mass Wt., Oz./yd.^{2} (2 layers)	Cohesion Tested By Hand	Porosity (Visual)
1	10	0.62	Fair to poor	Fair to good
2	14	0.72	Good	Good
3	16	0.898	Very good	Fair
4	18	1.1194	Very good	Fair to poor
5	20	1.31	Very good	Poor

Example 9

Tests were run to ascertain the extent to which hardness of the mass plays a part in the cohesiveness of the bandages described above. In these tests Natsyn 400 synthetic cis-polyisoprene mass having a "Williams" plasticity of 4.53 mm. and Uniroyal NC 400 M-30 rubber latex mass having a "Williams" plasticity of 7.95 mm. were employed.

The bandages were prepared by laying down the mass on silicone-coated carrier paper. For the Natsyn 400, a 14.8%-solids solution in xylene and a 16-mil bar coater setting were used. For the Uniroyal NC 400 M-30, which has a low viscosity, a 62%-solids dispersion and an S-46 (c) Meier bar were employed. While the masses were still wet, 1/32-inch, 80 ppi, Scott reticulated foam was applied and rolled lightly. After drying in a steam cabinet for 15 minutes at 160°F, the sheets were removed from the carrier paper and folded over, mass to mass, and rolled lightly to provide the bandages.

The bandage made with Natsyn 400 had good to very good cohesion. The bandage made with the Uniroyal NC 400 M-30 had almost no cohesion unless pressed very hard. Both samples exhibited no tack.

Example 10

An industrial-type adhesive (reinforced reclaimed rubber mass) was spread from a 20%-solids solution in xylene on silicone-coated carrier paper, using a 16-mil bar coater setting. While the mass was still wet, 1/32-inch thick, 80 ppi, Scott reticulated foam was placed on the surface and rolled lightly. After drying in a steam cabinet at 160°F for

15 minutes, the mass-coated foam was removed from the carrier.

With the mass surface facing up, the foam was stretched longitudinally by about 30 to 50% and held in that position while strands of reinforcing fiber glass threads (Owens Corning B150 1/0 1Z 636), each having a breaking strength of about 4 pounds, were laid on the mass surface in parallel relationship at a spacing of about 1/8 inch to 3/16 inch. The sample was folded over longitudinally and rolled to make a glass-reinforced cohesive tape having about 14 strands of glass thread per inch width. Tension was released and the tape did shrink back by about 10 to 15% of the stretched length. When the tape was pulled tight around a box and overlapped about 4 to 6 inches and pressed against itself, it bonded well and appeared to be a good strapping tape.

As those skilled in the art will recognize, the construction of the present invention lends itself to a variety of applications, both inside and outside the medical-surgical field, in addition to those already suggested. It can also be modified for particular applications, one contemplated modification, already suggested hereinabove, involving the substitution of substantially rigid structure, which may be porous or non-porous, for one of the outer webs. Thus the invention may be utilized in making floor coverings or the like in which a tile or other floor covering material replaces, for example, backing 18 of Figure 3, thereby providing a tile that can be moved at will until pressed into intimate contact with the surface to which it is to be adhered. Another application of this modification is using

the back of a plaque or the like as one of the webs, whereby the plaque may be readily secured to a wall surface merely by pressing it thereagainst.

Also, it is not essential that the products of the present invention be in flat or essentially sheet form. The foam may, for example, surround an inner adhesive core to form a rope-like structure. The adhesive is made available for adherence on compression of the outer foam surface. Products of this type may, for example, be useful as a caulking or filling material.

Such suggested applications are illustrative and represent only a few additional areas where the construction of the present invention may be advantageously employed. They are not to be considered in any way as limiting.

From the above description, it is apparent that the objections of the present invention have been achieved. While only certain embodiments have been described or illustrated, many alternative modifications and equivalents will be apparent from the above description to those skilled in the art. These and other alternatives and equivalents are considered within the spirit and scope of the present invention and coverage thereof is intended by the claims of any patents based on this application and any continuations or divisions thereof, even though not necessarily encompassed by the verbiage thereof.

The claims defining the invention are as follows :-

1. In an adhesive product:

(a) an adhesive mass, and

(b) a protective covering over said adhesive mass and adhered thereto, said protective covering having a thickness not substantially greater than about 1/16 inch and being formed of an open cellular resilient polymer material,

the adhesive mass becoming made available at the surface of said product by compression of said protective covering when adhering said product to other surfaces.

2. An adhesive product of claim 1 in which said open cellular resilient polymer material is a polyurethane foam.

3. An adhesive product of claim 1 in which said adhesive mass is a cohesive mass.

4. An adhesive product of claim 1 in which said adhesive mass is a pressure-sensitive adhesive.

5. In an article of manufacture:

(a) an outer flexible web which comprises compressible, open-cellular resilient foam having a pore count in the range of about 30 to 120 pores per linear inch;

(b) a backing; and

(c) an intermediate layer between said outer flexible web and backing and secured thereto, said intermediate layer comprising an adhesive mass having a "Williams"

plasticity within the range of 1-8 millimeters, the plasticity of such mass being such that the same is sufficient to extend through the pores of said foam when an external force is applied to said foam so as to compress the foam and expose portions of the mass at the external surface thereof.

6. An article of claim 5 in which said backing is formed of a substantially rigid material.

7. An article of claim 5 in which said backing is formed of flexible sheet material.

8. An article of claim 5 in which said outer flexible web and said backing comprise polyurethane foam.

9. A flexible wrapping comprising:

(a) outer flexible webs, at least one of which comprises compressible, open-cell polyurethane foam having a pore count in the range of about 30 to 120 pores per inch; and

(b) an intermediate layer secured to said outer webs and comprising an adhesive mass with sufficient plasticity to extend through said pores when an external compressive force is applied to said outer flexible webs so as to substantially compress said foam.

10. The wrapping of claim 9 wherein both said outer flexible webs comprise open-cell polyurethane foam.

11. The wrapping of claim 9 wherein the other of said webs comprises a flexible, substantially non-stretchable backing.

12. The wrapping of claim 9 wherein the other of said outer webs comprises a flexible non-woven plastic backing.

13. The wrapping of claim 9 wherein the other of said webs comprises a flexible paper backing.

14. The wrapping of claim 9 wherein said other of said webs has limited stretch properties relative to said polyurethane foam.

15. The wrapping of claim 9 including at least a third web intermediate the outer webs.

16. The wrapping of claim 15 wherein said third web comprises open-cell, polyurethane foam impregnated with said porous mass of said intermediate layer.

17. The wrapping of claim 15 wherein said third web has limited stretch properties relative to said polyurethane foam.

18. The wrapping of claim 15 including elongated, substantially non-stretchable reinforcing strands intermediate the outer webs.

19. The wrapping of claim 18 wherein said reinforcing strands comprise elongated, parallel strands of glass.

20. The wrapping of claim 9 wherein at least a portion of the mass of said intermediate layer is impregnated part way towards the surface of said foam.

21. The wrapping of claim 9 wherein said mass has a porous structure.

22. A closure tape for an article comprising:

(a) outer flexible webs, one of which comprises compressible, open-cell polyurethane foam having a pore count in the range of about

30 to 120 pores per inch, the other of which comprises a flexible backing having substantially less porosity and being substantially less stretchable relative to said polyurethane foam;

(b) an intermediate layer secured to said outer webs and comprising an adhesive mass having sufficient plasticity to extend through the pores of said foam when an external force is applied to said foam so as to compress the foam and expose portions of the mass at the external surface thereof; and

(c) means for securing said tape to the article to be closed.

23. A strapping tape comprising:

(a) outer flexible webs comprising open-cell polyurethane foam having a pore count in the range of about 30 to 120 pores per inch;

(b) an intermediate layer secured to said outer webs and comprising an adhesive mass having sufficient plasticity to extend through the pores of said foam when an external compressive force is applied to the surface of said foam so as to compress the foam and expose portions of the mass at the external surface thereof; and

(c) a plurality of parallel-disposed, substantially non-stretchable, relatively high-

tensile strength strands intermediate said outer flexible webs.

24. The strapping of claim 23 wherein said strands comprise glass imbedded in said intermediate layer.

25. A method of producing a limited-stretch strapping tape comprising:

(a) forming a laminate of

(i) outer layers comprising longitudinally-resiliently-stretched, compressible polyurethane foam having a pore count in the range of about 30 to 120 pores, and

(ii) an inner layer comprising a plurality of spaced, longitudinally parallel, substantially non-stretchable reinforcing strands and an adhesive mass secured to said outer layers and having sufficient plasticity to extend through the pores of said foam when compressive forces are applied to the external surfaces of said foam; and

(b) relieving the longitudinal stretching forces on said foam whereby the laminate longitudinally shrinks.

26. The method of claim 25 wherein said strands comprise glass imbedded in said mass.

DATED this 18th day of September 1974.

JOHNSON & JOHNSON
By their Patent Attorney:

of GRIFFITH HASSEL AND FRAZER

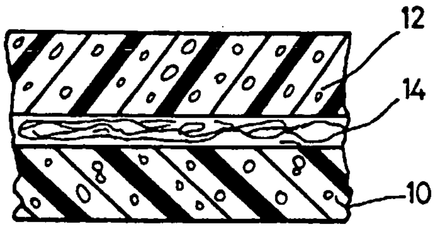

FIG. 1

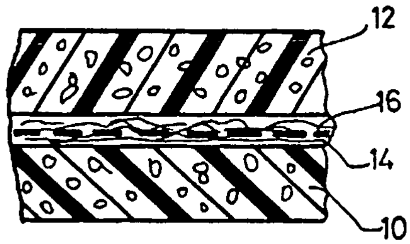

FIG. 2

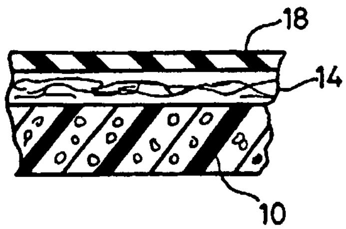

FIG. 3

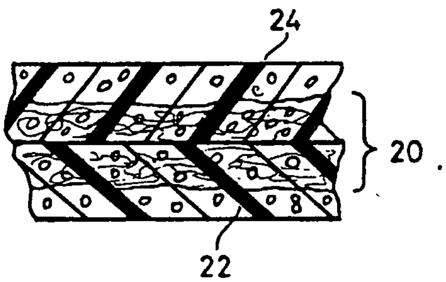

FIG. 4

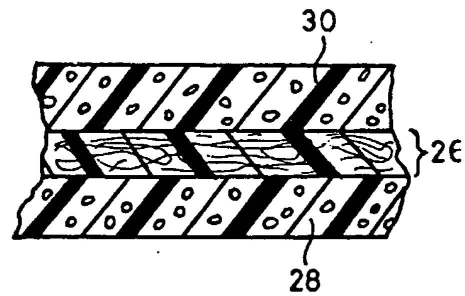

FIG. 5

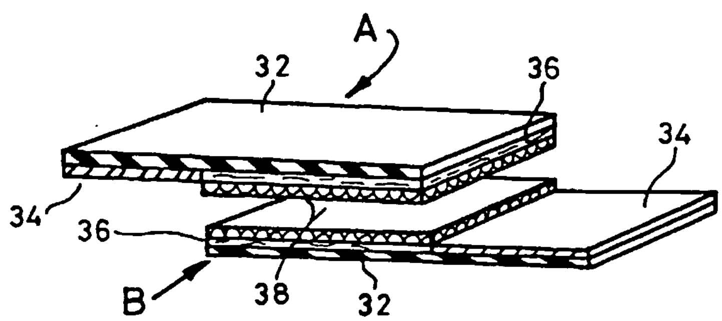

FIG. 6

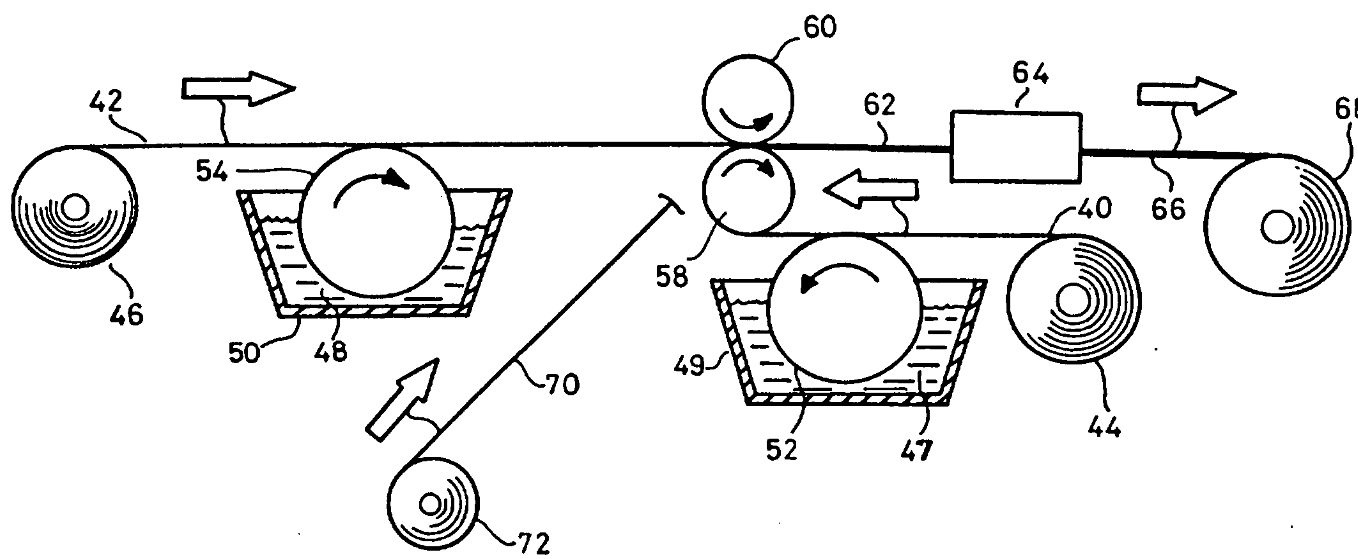

FIG. 7